Ballistic Pendulum

Name: _____ Section: 2AL-___ Date performed: __/__/__

Lab station: _____ Partners: _____

Finding the muzzle velocity using the ballistic pendulum

Determine the height of the ball at launch time (h_{ball}) and the height of the pivot (h_{pivot}), and use these values to compute r.

$h_{\text{ball}} =$ _____ $h_{\text{pivot}} =$ _____ $r = \Delta h =$ _____

Measure the mass of the ball (m) and record the mass of the pendulum (M).

$m =$ _____ $M =$ _____

Measure the initial height of the pendulum+ball center of mass.

$h_i =$ _____

Fire the ball several times until you have determined the highest point reached by the pendulum. Measure the final height of the pendulum+ball center of mass, and calculate the change in height after the collision.

$h_f =$ _____

$h = h_f - h_i =$ _____

Use conservation of mechanical energy to determine the angular velocity of the pendulum+ball just after the collision.

$\omega_2 =$ _____ rad/s

Use conservation of angular momentum to determine the initial (launch) velocity of the ball.

$v_1 =$ _____

Record the launch velocity written on the ballistic pendulum.

Recorded $v_1 =$ _____

Checking the value of the muzzle velocity

Arrange the ballistic pendulum to launch the ball horizontally. Measure the launch height of the ball above the ground.

$Y =$ _____

Calculate the expected horizontal displacement (X) based on your values of Y and v_1 (use *your* value of v_1). (Hint: how much time does the ball spend in the air?)

$X =$ _____

Place the target paper on the ground so that the target line (in the middle) is located a horizontal distance X away from the launch point and fire several shots at the target page. Use carbon paper to allow the ball to mark where it comes down on the target paper.

How far does each shot land from the target line (in cm)? Include sign (+ for overshoot, − for undershoot).

_____ _____ _____ _____ _____ _____

Name of lab partner who is turning in the target paper: _____

Exercises

What is the magnitude of the horizontal component of the acceleration of the ball while it is in free-fall (second part of the lab)?

(A) zero.
(B) v_1/t.
(C) ω_2/t.
(D) g.

What is the magnitude of the vertical component of the acceleration of the ball while it is in free-fall?

(A) zero.
(B) v_1/t.
(C) ω_2/t.
(D) g.

The target paper should be placed on the ground so that the target line is a horizontal distance X away from

(A) the ball's initial position when the spring is compressed.
(B) the location of the ball when it is released from the gun and begins to fall.
(C) the front edge of the base of the ballistic pendulum.
(D) the front edge of the lab table.

Explain:

The vertical distance Y should be measured from _____ to the floor.

(A) top of the ball
(B) bottom of the ball
(C) base of the ballistic pendulum
(D) top of the lab table

Explain:

Which of the quantities listed below is/are conserved during the collision between the ball and the pendulum? Choose all that apply.

(A) Linear momentum of the ball+pendulum system.
(B) Angular momentum of the ball+pendulum system.
(C) Mechanical energy of the ball+pendulum system.
(D) Speed of the ball.

Which of the quantities listed below is/are conserved during the rise of the ballistic pendulum between the time just after the collision and when the pendulum reaches its highest point? Choose all that apply.

(A) Linear momentum of the ball+pendulum system.
(B) Angular momentum of the ball+pendulum system.
(C) Mechanical energy of the ball+pendulum system.
(D) Speed of the ball.

What is the rack and pawl designed to do?

(A) Keep the ball from falling out of the pendulum.
(B) Prevent the apparatus from recoiling when the gun is fired.
(C) Act as shock absorbers to minimize noise and vibration when the gun is fired.
(D) Capture the rising pendulum at its highest position.

Why did we disable the pawl?

(A) Because the lab manual says so.
(B) Because otherwise the rack and pawl system would introduce an unacceptable amount of friction.
(C) Disabling the pawl reduced the rotational inertia of the pendulum to an acceptable level.
(D) If the pawl were enabled, angular momentum would not be conserved during the collision between the ball and the pendulum.